H02K 15/10E

PATENT SPECIFICATION 910,297

DRAWINGS ATTACHED.

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COMPLETE SPECIFICATION.

Coil Coating Method.

We, CHRYSLER CORPORATION, a corporation organised under the laws of the State of Delaware, United States of America, of 341 Massachusetts Avenue, Highland Park, Detroit, State of Michigan, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement :—

This invention relates to a method of providing electrical wires with a protective resinous coating, and further concerns the bonding of closely laid wires by said resin coating into a rigid unit. Particular emphasis is herein placed on coating and bonding together the coils of such electrical apparatus as stators and rotors.

Heretofore such coatings for the protection of coils against moisture and for bonding stator and rotor coils into rigid units have been provided, for example, by such techniques as masking and spraying with protective liquid resin, and masking and dipping into said resin. Significant limitations, however, on these coating methods have been observed particularly in the areas of adaptation to mass production, required manpower, manufacturing costs, and quality of the coated structures for the intended use.

The present invention prescribes a method which is void of these limitations and produces a significantly higher quality product.

A principal object of this invention is to provide a method for effectively coating the electrical windings of stators, rotors and other electrical apparatus with a protective and rigidifying plastic coating after the windings have been assembled on their supporting structures and without the aid of any masking materials and/or structures.

A specific object is to provide a method for accomplishing the above objective utilizing curable powdered resinous materials as the protective and rigidifying coating in one stage of the coating operation.

Another object is to provide a method and means for effectively securing stator coils in place in the stator slots without the aid of plugs or other separate coil retaining devices.

A further object is to add dielectric strength to the coil insulation and thereby increase the allowable operating temperature of the apparatus over conventionally wound and insulated apparatus.

According to the invention, there is provided a method of protectively and insulatively coating electrical coils comprising the steps of connecting said coils to a source of electrical power to resistance heat the same, and bringing said heated coils into contact with powdered hardenable resin whereby said resin will be picked up on the surface thereof in sufficient quantity to form a continuous coating thereon.

The invention also includes a method of simultaneously protectively coating and bonding a plurality of adjacent electrically conductive coils, such as stator windings, into a relatively rigid unit comprising the steps of connecting said coils to a source of electrical power to resistance heat the same, and bringing said heated coils into contact with powdered hardenable or thermosetting resin whereby said resin will be picked up on the surface of said coils in sufficient quantity to partially impregnate the interstices between said coils and form a continuous resin coating interconnecting the same.

Finally, the invention includes a method of making a rigid stator structure comprising the steps of winding insulated elecitrcal

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wires into the slots of a stator stack to provide the required stator windings, connecting each of said windings to a source of electrical power to heat said windings to within a predetermined temperature range, bringing the stator assembly into contact with powdered resinous material at least a portion of which has a melting temperature below said temperature range to cause said material to adhere to said windings, and thereafter causing said material to harden.

In order that the invention may be understood, it will now be described with reference to the accompanying drawings, in which :—

Figure 1 represents an isometric view of a stator stack partially coated with resin and forming the mandrel upon which the stator coils are wound and permanently assembled ;

Figure 2 represents a cross sectional view of Figure 1 taken along the line 2—2 thereof in the direction of the arrows showing a portion of the coated stator ;

Figure 3 is a view of the stator stack of Figure 1 having the stator coils wound thereon ;

Figure 4 represents the assembly of Figure 3 with the protective and rigidifying resin coating thereon ;

Figure 5 represents a cross sectional view of the structure of Figure 4 taken along the line corresponding to 5—5 thereof in the direction of the arrows ;

Figure 6 schematically represents a method of connecting the various coil leads to a multiphase power source ; and

Figure 7 schematically represents a method of connecting the various coil leads in series to a common power source.

Referring to the drawings, a laminated stator stack designated 10 having slots 12 around the inner periphery thereof is shown to be provided with a plastic coating 14 completely covering the slots 12 but being absent from the pole ends 16 and assembly flange 18. A plurality of rivets 23 retain the stack laminations in compression. Apertures 22 are provided in the stack for subsequent assembly of the stator in the motor structure.

In Figure 3 the stator stack is shown assembled with three separate coils or windings represented by A, B, and C and this stator, therefore, is intended for use in a 3-phase motor or generator. For the purposes of this invention, however, any winding arrangement can be provided on the stator and it is not our intention to be limited by any specific motor or generator structure. The coils A, B, and C are formed from insulated wires as shown in Figure 5.

The present method of simultaneously protectively coating and bonding is carried out by the steps of connecting the coils A, B, and C in either a 3-phase circuit or a series circuit representative ones of which are shown in Figures 6 and 7 respectively. The particular manner in which these coils are connected to an electrical power source is not critical and any circuit which can resistance heat these coils without significantly heating the stator stack is acceptable. After the coils have been heated to a sufficiently high temperature the whole assembly of Figure 3 is either dipped into a container of fluidized thermosetting or thermoplastic resin powder, or is sprayed with such powder which sticks to the heated insulation 24 of the wires but does not stick to the unheated stator. The particular resin employed may be chosen from a number of well known resin powders presently on the market such as thermosetting Epoxy, and thermoplastic cellulosics, vinyls, Nylon, polyethylene, and chlorinated polyethers. The temperature to which the wires must be brought to cause such resins to adhere thereto will vary according to the resin used.

An example of a preferable powder is a solid Epoxy blended with solid curing agents such as dicyandiamide. Variation in the formation can be made to control flow, flexibility, cost according to well known manufacturing procedures by the addition of controlled amounts of plasticizers, fillers, and various curing agents. The temperature to which the wires must be brought to cause adherence of this Epoxy resin powder thereto is slightly above the resin melt temperature which would be within the range of about 250° F.—450° F. The temperature to which the coated assembly must then be brought to finally cure this resin is approximately 300° F.—350° F. This final curing step, if found to be necessary due to lack of heat retention by the coils, may conveniently be accomplished by means of a conveyor type curing oven for mass production operations. In this regard the heat retained by the wires, and the composition of the thermosetting powder system may conveniently be adjusted to give a final resin cure without additional heat. When thermoplastic powders are used, merely cooling the coated assembly down to harden the resin may be sufficient.

It is seen that during the powder pickup on the wires, a significant portion of the powder will permeate in the interstices between the wires and sufficient powder will be thus adhered so that when it hardens under cure it will plastically weld substantially the entire coil structure into a rigid unit practically impervious to deleterious atmospheres and highly cushioned against abrasion due to shock. Moreover, it is particularly noted that by the use of such a method the formerly used coil retaining plugs may be conveniently eliminated.

WHAT WE CLAIM IS :—

1. A method of protectively and insulatively coating electrical coils comprising the steps of connecting said coils to a source of electrical power to resistance heat the same, and bringing said heated coils into contact with powdered hardenable resin whereby said resin will be picked up on the surface thereof in sufficient quantity to form a continuous coating thereon.

2. The method as claimed in Claim 1, wherein said powdered resin is thermosetting. (warm curing)

3. A method of simultaneously protectively coating and bonding a plurality of adjacent electrically conductive coils, such as stator windings, into a relatively rigid unit comprising the steps of connecting said coils to a source of electrical power to resistance heat the same, and bringing said heated coils into contact with powdered hardenable or thermosetting resin whereby said resin will be picked up on the surface of said coils in sufficient quantity to partially impregnate the interstices between said coils and form a continuous resin coating interconnecting the same.

4. A method of making a rigid stator structure comprising the steps of winding insulated electrical wires into the slots of a stator stack to provide the required stator windings, connecting each of said windings to a source of electrical power to heat said windings to within a predetermined temperature range, bringing the stator assembly into contact with powdered resinous material at least a portion of which has a melting temperature below said temperature range to cause said material to adhere to said windings, and thereafter causing said material to harden.

5. The method of insulatively coating substantially as described with reference to the accompanying drawings.

6. The method of simultaneously protectively coating and bonding substantially as described with reference to the accompanying drawings.

7. The method of making a rigid stator structure substantially as described with reference to the accompanying drawings.

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2 SHEETS

COMPLETE SPECIFICATION

This drawing is a reproduction of the Original on a reduced scale

Sheets 1 & 2

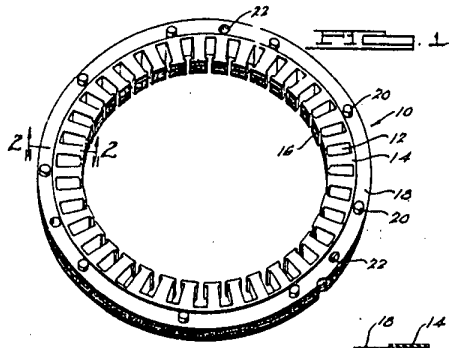

FIG. 1.

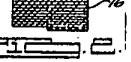

FIG. 6.

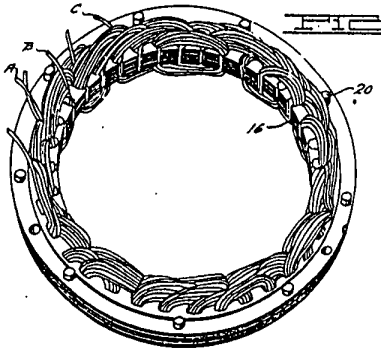

FIG. 3.

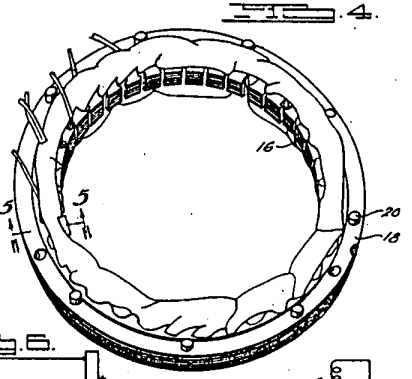

FIG. 4.

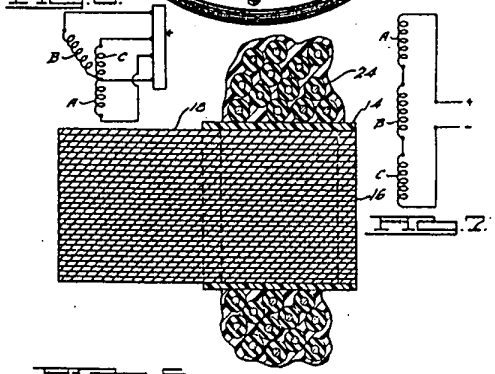

FIG. 5.

FIG. 7.